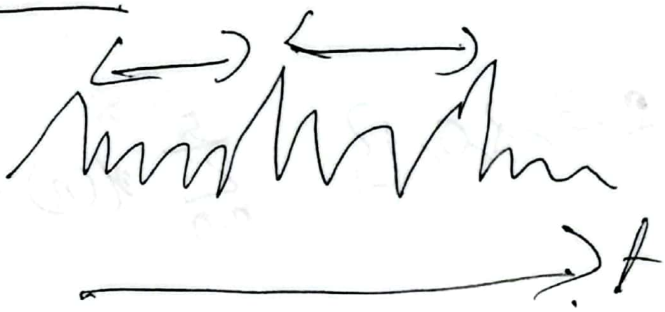
DSP - final — 1st class. 19/09/22

z - Transform:



~~$z = re^{j\omega}$~~

$z = re^{j\omega}$ → অনেক[illegible]

The z- transform of a DT signal $x(n)$ is defines as the power series

$$X(z) = \sum_{n=-\infty}^{\infty} x(n)\, z^{-n}$$

z is a complex variable

$$x(n) \xleftrightarrow{z} X(z)$$

z transpose exists only for those values of z for which the series converges. The region of convergence (ROC) of $X(z)$ is the set of all values of z for which $X(z)$ attains a finite value.

Ex: 3.1.1

$x_1(n) = \{1, 2, 5, 7, 0, 1\}$ $\sum_{n=0}^{5} x(n) z^{-n}$

$= x(0) z^{-0} + x(1) z^{-1} + x(2) z^{-2} + x(3) z^{-3} + x(4) z^{-4} + x(5) z^{-5}$

$= 1 + 2z^{-1} + 5z^{-2} + 7z^{-3} + z^{-5}$

ROC: entire z-plane except $z = 0$

$x_2(n) = \{1, 2, 5, 7, 0, 1\}$

$= z^2 + 2z + 5 + 7z^{-1} + z^{-3}$, ROC: entire z-plan except $z = 0$ and $z = \infty$

$x_3(n) = \delta(n)$

$X(z) = 1$

ROC: 1, Entire z Plane.

$x_{\cancel{z}}(n) = \delta(n+K)$

$X(z) = z^{K}$

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DSP Final - 2nd class

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Ch:- 3 : z - Transform:

$$X(z) = \sum_{n=-\infty}^{\infty} x(n) z^{-n} \quad , \quad z = re^{j\omega}$$

Ex. $x(n) = \{1, 2, \underset{\uparrow}{5}, \cancel{7}, 0, 1\}$

$n = -2 \quad -1 \quad 0 \quad 1 \quad 2 \quad 3$

$$X(z) = x(-2)\cdot z^{2} + x(-1)\cdot z^{1} + x(0)\cdot z^{-0} + x(1)\cdot z^{-1} + x(2)\cdot z^{-2} + x(3) z^{-3}$$

$$X(z) = z^{2} + 2z + 5 + \cancel{7}z^{-1} + z^{-3}$$

ROC :- all values of z except $z = 0, \infty$

Region of Convergence

∞ → infinite.

~~Ans~~

Ex. 3.1.2 Determine the z-transform of the signal $x(n) = \left(\frac{1}{2}\right)^{n} u(n)$

$u(n) = \{1, 1, 1 \cdots\}$
$n = 0 \ 1 \ 2$

$x(n) = \{1, \frac{1}{2}, (\frac{1}{2})^{2}, (\frac{1}{2})^{3}, \cdots\}$

$n = 0, 1, 2, 3, \ldots$

P.t.o

$$x(z) = 1 + \frac{1}{2}z^{-1} + \left(\frac{1}{2}\right)^2 z^{-2} + \left(\frac{1}{2}\right)^3 z^{-3} + \cdots$$

$$= 1 + A + A^2 + A^3 + \cdots\cdots$$

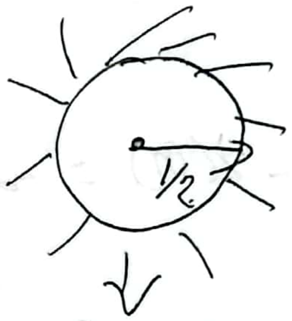
$$= \frac{1}{1-A}, \text{ for } A < 1.$$

$$x(z) = \frac{1}{1 - \frac{1}{2}z^{-1}}$$

$|A| < 1$

$= \left|\frac{1}{2}z^{-1}\right| < 1$

$= z > \frac{1}{2} \rightarrow$ ROC



ROC Figure (Most Important)

[For a right-hand signal the ROC is outside the circle.]

Ex. 3-1.3 Determine the z-transform of the signal.

$$x(n) = \alpha^n u(n) \begin{cases} \alpha^n, & n \geq 0 \\ 0, & n < 0 \end{cases} \rightarrow \text{right handside signal.}$$

alpha

$$x(z) = \sum_{n=0}^{\infty} \alpha^n z^{-n} = \sum_{n=0}^{\infty} (\alpha z^{-1})^n$$

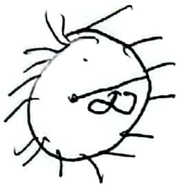
infinity

p.t.o

[R.H.S হলে যার উপরের Power(n) তার outerside হবে ROC] Suppose α^n

$$x(z) = \frac{1}{1 - \text{alpha}\, z^{-1}}$$

$|\text{alpha}\, z^{-1}| < 1, \longrightarrow |z| > \text{alpha} : [\text{ROC}]$



ROC [outerside of alpha)

EX. 3.1.4 $\quad x(n) = -\alpha^n u(-n-1)$

$$\begin{cases} 0, & n \geq 0 \\ -\alpha^n, & n \leq -1 \end{cases}$$

$u(-n-1) \geq$

Left-hand side signal

$$X(z) = \sum_{n=-\infty}^{-1} (-\alpha^n) z^{-n}$$

$$= -\sum_{n=-1}^{-\infty} (\alpha^{-1} z)^{-n}$$

$$= \sum_{l=1}^{\infty} (\alpha^{-1} z)^{l} \quad \boxed{l = -n}$$

$$= \cancel{1+}\, A + A^2 + A^3 + \ldots$$

$$= A(1 + A + A^2 + A^3 + \ldots)$$

$$x(z) = \frac{A}{1-A}$$

$$= \frac{\alpha^{-1}z}{1-\alpha^{-1}z} = \frac{1}{\frac{1}{\alpha^{-1}z}-1}$$

$$= \frac{1}{1-\alpha z^{-1}}, \quad |\alpha^{-1}z|<1$$

ROC: $|z| < \alpha$

ROC:  [ROC of a left-hand side signal is the interior of a circle]

Ans

Ex: 3.1.5

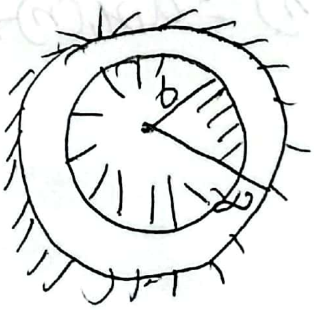
$$x(n) = \alpha^n u(n) + b^n u(-n-1)$$

$$X(z) = \frac{1}{1-\alpha z^{-1}} - \frac{1}{1-bz^{-1}}$$

ROC: $|z| > \alpha$ ROC: $|z| < b$

Case 1: $|b| < |\alpha|$

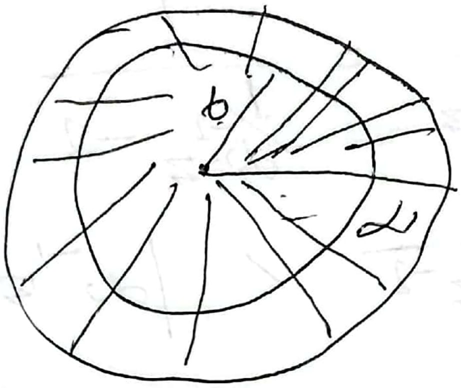
ROC does not exist!



ROC doesn't exist.

P.T.O

Case 2: $|b| > |\alpha|$



ROC: $|\alpha| < |z| < |b|$

Table – 3.1 [অবশ্যই দেখতে হবে question আসবে]

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3.2 Properties of z-transform

Linearity: If $x_1(n) \xleftrightarrow{z} X_1(z)$

$x_2(n) \longleftrightarrow X_2(z)$

Then $x(n) = a_1 x_1(n) + a_2 x_2(n) \xleftrightarrow{z} a_1 X_1(z) + a_2 X_2(z)$

গুনত্তর সিরিজের Summation এর equation Finite হলে $\Rightarrow \dfrac{1-a^N}{1-a}$

Infinite হলে $\Rightarrow \dfrac{1}{1-a}$

Ex:- 3.2.1

$a^n u(n) \xrightarrow{z} \dfrac{1}{1-az^{-1}}$

$$x(n) = [3(2^n) - 4(3^n)]\, u(n)$$

$$= 3(2^n)\, u(n) - 4(3^n)\, u(n)$$

$$X(z) = \frac{3}{1-2z^{-1}} - \frac{4}{1-3z^{-1}}$$

Time shifting:- If $x(n) \xrightarrow{z} X(z)$

$$x(n-k) \xrightarrow{z} z^{-k} X(z)$$

$\delta(n) \xrightarrow{z} 1$

$\delta(n-k) \rightarrow z^{-k}$

Ex. (3.2.3) ⇒ H.W

Ex: 3.2.4:

$$x(n) = \begin{cases} 1, & 0 \leq n \leq N-1 \\ 0, & \text{else where.} \end{cases}$$

$$X(z) = \sum_{n=0}^{N-1} 1 \cdot z^{-n} = 1 + z^{-1} + z^{-2} + z^{-3} + \cdots + z^{N-1}$$

$$= \frac{1-z^{-N}}{1-z^{-1}}$$

Formula.

Find the z-transform:

$$x(n) = u(n) - u(n-N)$$

$$X(z) = Z[u(n) - u(n-N)]$$

$$= Z[u(n)] - Z[u(n-N)]$$

$$= \frac{1}{1-z^{-1}} - z^{-N} \cdot \frac{1}{1-z^{-1}}$$

$$= (1 - z^{-N}) \cdot \frac{1}{1-z^{-1}}$$

⊛ Differentiation in the z-domain:

If $x(n) \xleftrightarrow{z} X(z)$

then $n\,x(n) \longleftrightarrow -z \frac{dX(z)}{dz}$ ⇒ (Proof book অনুযায়ী).

Ex-3.2.7: $x(n) = n a^n u(n)$ ⇒ z-transform $\frac{1}{1-az^{-1}}$

$$n a^n u(n) = -z \frac{d}{dz}\left[\frac{1}{1-az^{-1}}\right] = -z$$

Differentiate

$(1-az^{-1})^{-1}$

$\frac{-az^{-2}}{(1-az^{-1})^2}$

$$= \frac{az^{-1}}{(1-az^{-1})^2} \text{ Ans.}$$

Convolution of two sequences:- [Most Important Property]

If $x_1(n) \longrightarrow X_1(z)$

$x_2(n) \longrightarrow \cancel{x_2}\ X_2(z)$

$$x_1(n) * x_2(n) \xleftrightarrow{z} X_1(z) \cdot X_2(z)$$

$\xrightarrow{\text{Inverse } z} x_1(n) * x_2(n)$

$X(z) \longrightarrow x(n)$

Ex.-3.2.9:-

$\boxed{x(z) = \sum x(n) z^{-n}}$

$x_1(n) = \{1, -2, \underline{1}\}$, $x_2(n) = \{1, 1, 1, 1, 1, 1\}$

Compute the convolution $x(n)$ of the signals:-

$x_1(z) = 1 - 2z^{-1} + z^{-2}$

$x_2(z) = 1 + z^{-1} + z^{-2} + z^{-3} + z^{-4} + z^{-5}$

$x(z) = x_1(z) \cdot x_2(z) = 1 - z^{-1} - z^{-6} + z^{-7}$

$x(n) = \{1, -1, 0, 0, 0, 0, -1, 1\}$

Ans.

Steps for finding convolution using z-transform

1. compute the z-tran. of the signals tobe convolved.

$$x_1(z) = z\{x_1(n)\}$$
$$x_2(z) = z\{x_2(n)\}$$

2. multiply the two z-transform:

$$x(z) = x_1(z)\, x_2(z)$$

3. Find the inverse z-transform of $x(z)$

$$x(n) = z^{-1}\{x(z)\}$$

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3.3 : Rational z - Transform:-

$$X(z) = \frac{B(z)}{A(z)}$$

$$= \frac{b_0 + b_1 z^{-1} + \cdots + b_m z^{-M}}{a_0 + a_1 z^{-1} + \cdots + a_N z^{-N}} \quad \text{[polynomial]}$$

$$= C \frac{(z - z_1)(z - z_2) \cdots (z - z_m)}{(z - P_1)(z - P_2) \cdots (z - P_N)} \quad (z_1, P_1 \cdots \text{এরা roots.})$$

(this is roots) (this not আসে) ওর

Poles and zeros:

The zeros of z - transform $X(z)$ are the values of z for which $X(z) = 0$
[zeros : $z_1, z_2, z_3, \cdots z_m$].

The Poles of a z - transform are the values of z - for which $X(z) = \infty$.

[Poles : $P_1, P_2, P_3, \cdots P_N$].

(Roots of the denominator) হয়

Ex: 3.3.1

Determine the Pole-zero Plot for the signal

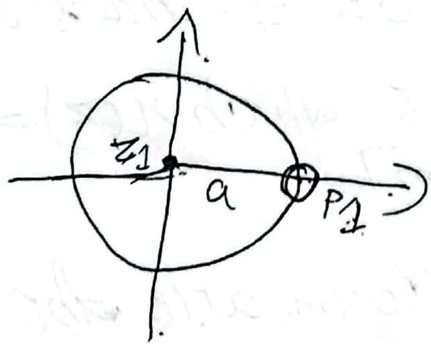
$$x(n) = a^n u(n)$$

$$X(z) = \frac{1}{1-az^{-1}}$$

Zero: $z_1 = 0$
Pole: $p_1 = a$

$$= \frac{1}{1 - \frac{a}{z}}$$

$$= \frac{1}{\frac{z-a}{z}} = \frac{(z-0)}{(z-a)}$$

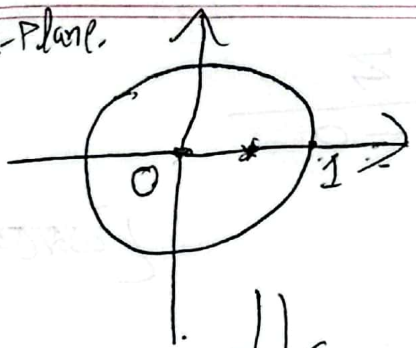


Ex 3.3.2: Pole-zero location and time-domain Behaviour for causal signals:

$$x(n) = a^n u(n) \longleftrightarrow X(z) = \frac{1}{1-az^{-1}}$$

$$= \frac{z}{z-a}$$

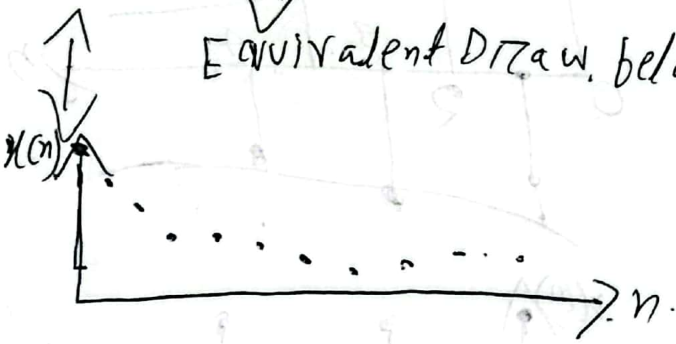
(*) z-Plane.



[Exponential হবে.]

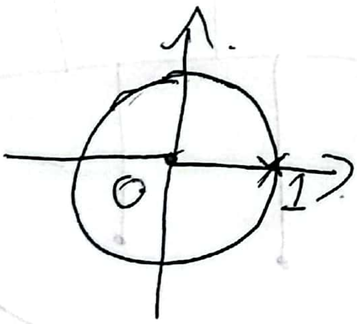
~~মানে কমাবে~~

Equivalent Draw below

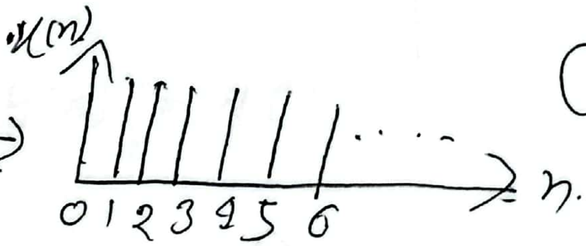


(কমতেছে)

(*) $x(n) = a^n u(n) \longrightarrow \frac{z}{z-a}$

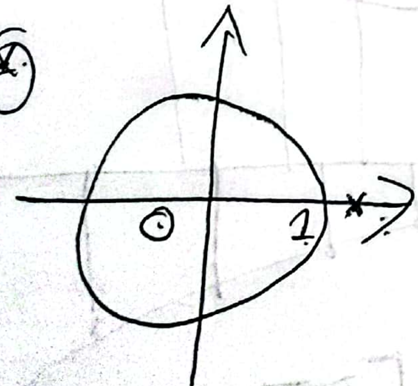


$\longleftrightarrow$

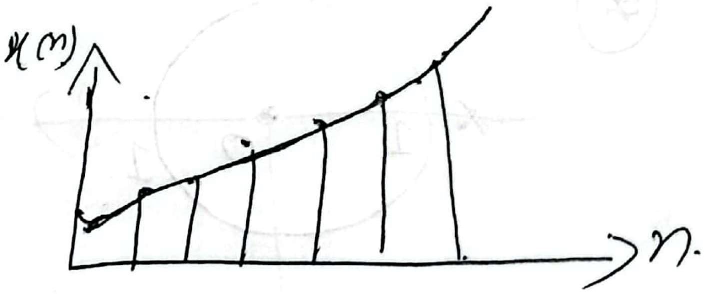


(সমান)

(*)

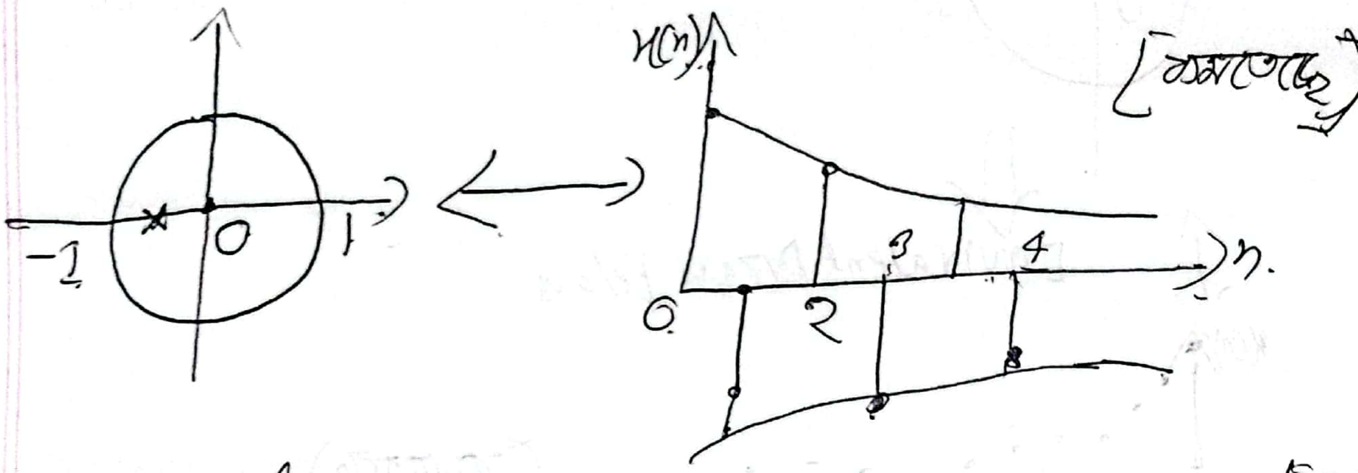


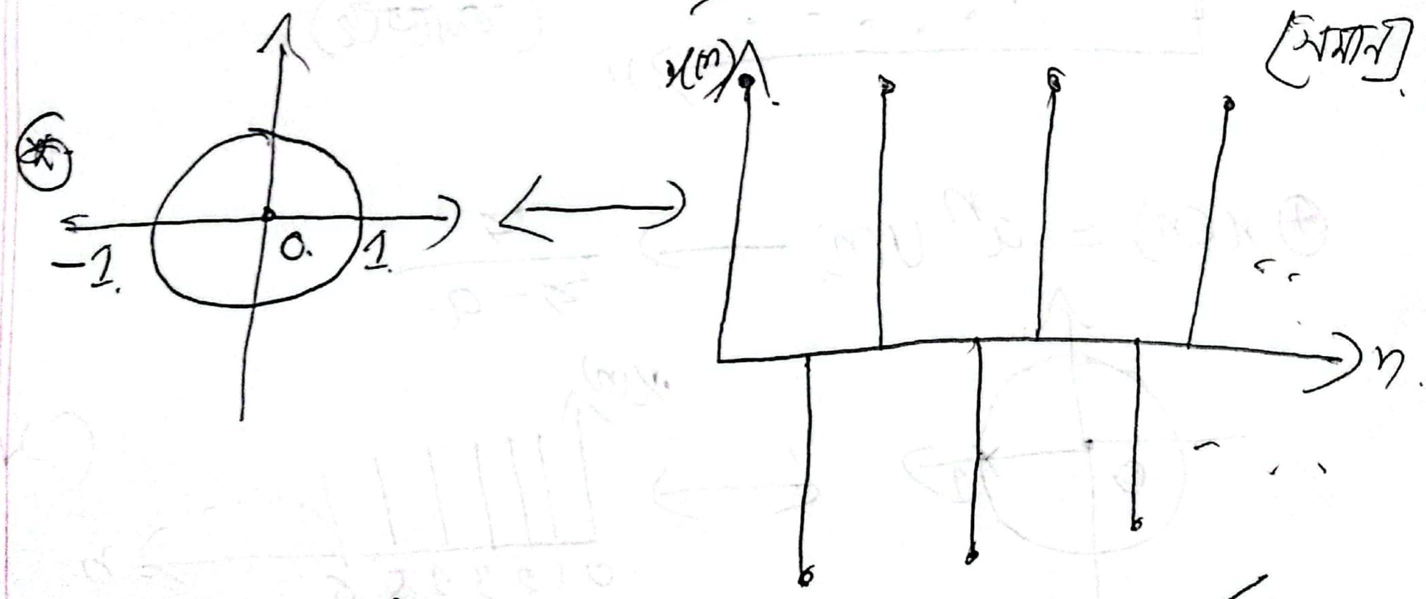
$\longleftrightarrow$

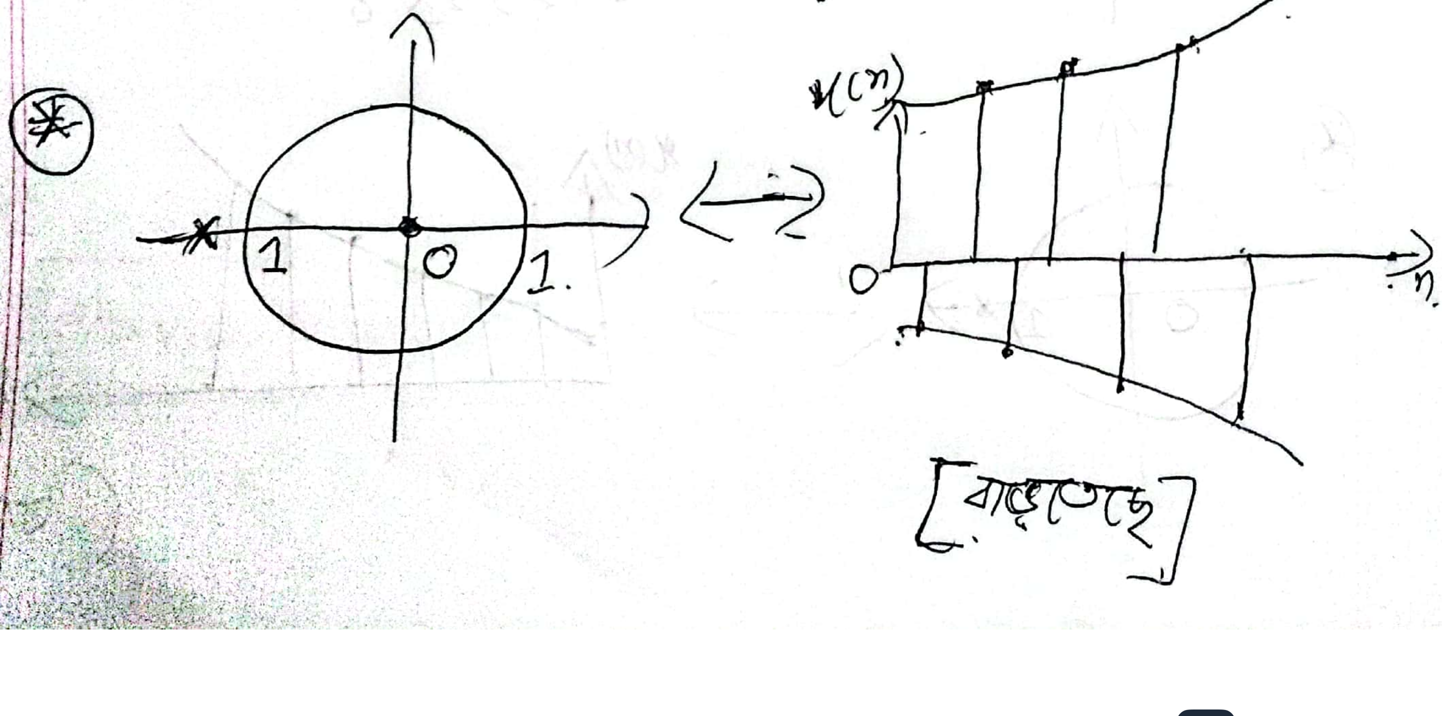


(বাড়তেছে).

$$x(n) = a^n u(n) \longrightarrow \frac{z}{z-a}$$







Time domain এর convolution

z- " এর Multiplication

(*) 3.3.3 The system function of an LTI system.

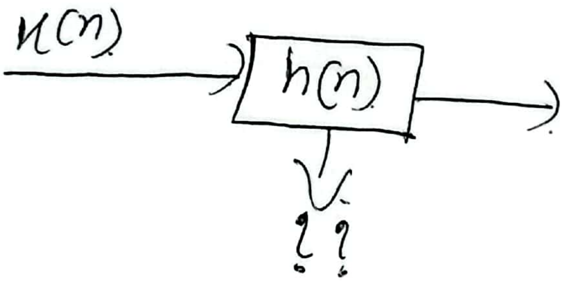
$$y(n) = x(n) * h(n)$$

$$Y(z) = \cancel{X(z) \cdot H}$$

$$= X(z) \cdot H(z)$$

$$H(z) = \frac{Y(z) \rightarrow \text{output}}{X(z) \rightarrow \text{Input}}$$

$\rightarrow$ System. Function.



$y(n) = x(n) * h(n)$

(*) Ex:- Determine the system function and unit sample response:-

$$y(n) = \frac{1}{2} y(n-1) + 2x(n)$$

$H(z) = ?$

$h(n) = ?$

$H(z) = \frac{Y(z)}{X(z)}$

$$Y(z) = \frac{1}{2} z^{-1} Y(z) + 2X(z)$$

$$2X(z) = Y(z) \left[1 - \frac{1}{2} z^{-1}\right]$$

p.t.o

$\Rightarrow$ System Function

$$\frac{y(z)}{x(z)} = \frac{2}{1-\frac{1}{2}z^{-1}} \Rightarrow H(z) = \frac{2}{1-\frac{1}{2}z^{-1}}$$

$$h(n) = 2\cdot\left(\frac{1}{2}\right)^n u(n)$$

[z করলে H(z) পাবো, Inverse করলে h(n) পাবো]

Ans.

$$\frac{Y(z)}{X(z)} = \frac{2}{1-\frac{1}{2}z^{-1}} \Rightarrow H(z) = \frac{2}{1-\frac{1}{2}z^{-1}} \Rightarrow \text{System Function}$$

$$h(n) = 2\cdot\left(\frac{1}{2}\right)^n u(n)$$

[z করলে H(z) পাবো, Inverse করলে h(n) পাবো]

Ans.

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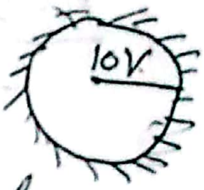
⊛ Inverse z-transform:

Ex. $X(z) = \frac{1}{1-az^{-1}}$, $|z| > |a|$ → causal signal



$x(n) = a^n u(n)$ ✓ | $a^n u(-n-1)$ ✗ → anti causal হবেনা

⊛ The inverse z-transform by Power-series expansion:

Ex. 3.4.2 Determine the inverse z-tran of.

p.t.o

$$x(z) = \frac{1}{1 - 1.5z^{-1} + 0.5z^{-2}}$$

when - (a) ROC: $|z| > 1 \rightarrow x(n)$ should be causal.

(b) ROC: $|z| < 0.5 \rightarrow x(n)$ " " anti- "

$x(n) = \{1, 2, 3\} \Rightarrow$ R.H.Signal

$x(z) = \{1 + 2z^{-1} + 3z^{-2}\}$

$$x(z) = \sum_{n=-\infty}^{\infty} x(n) z^{-n}$$

$x(n) = \{1, 2, 3\} \Rightarrow$ L.H.Signal.

$x(z) = z^{+2} + 2z^{+1} + 3$

Ex. 3.4.2:- $x(z) = \frac{1}{1 - \frac{3}{2}z^{-1} + \frac{1}{2}z^{-2}} \longrightarrow z^{-1} + z^{-2} + z^{-3} + \ldots$

$$1 - \frac{3}{2}z^{-1} + \frac{1}{2}z^{-2} \Big) \; 1 - \frac{3}{2}z^{-1} + \frac{1}{2}z^{-2} \Big(\; 1 + \frac{3}{2}z^{-1} + \frac{7}{4}z^{-2} + \ldots$$

$$\frac{3}{2}z^{-1} - \frac{1}{2}z^{-2}$$

$$\frac{3}{2}z^{-1} - \frac{9}{4}z^{-2} + \frac{3}{4}z^{-3}$$

$$\frac{7}{4}z^{-2} - \frac{3}{4}z^{-3}$$

$x(n) = \{1, \frac{3}{2}, \frac{7}{4}, \ldots\}$

3.4.8: $X(z) = \dfrac{1}{1 - 1.5z^{-1} + 0.5z^{-2}}$ $x(n) = ?$

(a) ROC: $|z| > 1 \rightarrow$ causal.

(b) ROC: $|z| < 0.5 \rightarrow$ anti "

(c) ROC: $0.5 < |z| < 1 \rightarrow$ contain both causal & anticausal part.

নিলে যায়: $X(z) = \dfrac{2}{1 - z^{-1}} - \dfrac{1}{1 - 0.5z^{-1}}$

$X(z) = \dfrac{1}{1 - az^{-1}}$

$x(n) = a^n u(n)$

(a) $x(n) = 2(1)^n u(n) - (0.5)^n u(n)$

(b) $x(n) = 2(1)^n u(-n-1) - (0.5)^n u(-n-1)$

(c) $x(n) = -2(1)^n u(-n-1) - (0.5)^n u(n)$

DSP - 6th class
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02/05/23

Z- Transform

$$X(z) = \sum_{n=-\infty}^{\infty} x(n) z^{-n}$$

$$x(n) = \{1, 2, \underline{5}, \lambda, \underline{0}, 1\}$$

$$X(z) = 1 + 2z^{-1} + 5z^{-2} + \lambda z^{-3} + z^{-5}$$

$$X(z) = z^{2} + 2z^{1} + 5 + \lambda z^{-1} + z^{-3}$$

① $x(n) = \delta(n)$

$$X(z) = 1 \cdot z^{-0}$$

$$= 1$$

$x(n) = \delta(n-k)$

$$X(z) = z^{-k}$$

$x(n) = \delta(n+k)$

$$X(z) = z^{k}$$

⑤ $x(n) = a^n u(n)$

$X(z) = \sum x(n) z^{-n}$

$= \sum a^n z^{-n}$

$= \sum_{n=-\infty}^{\infty} (az^{-1})^n = \frac{1}{1-az^{-1}}$,

$|az^{-1}| < 1$

$\underline{z > |a|}$

ROC $\underline{\text{Ans}}$

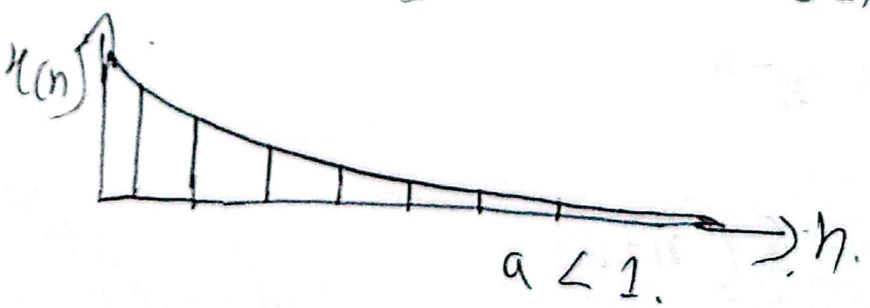
⑥ $x(n) = a^n u(-n-1)$

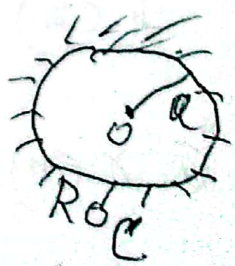
$\frac{1}{1-az^{-1}}$, $|z| < a$.

$\underline{\text{Ans}}$.

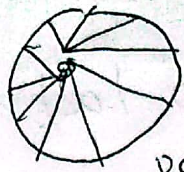
⑦ $x(n) = a^n u(n)$ $a < 1$ (Signal Draw):

R.H.S





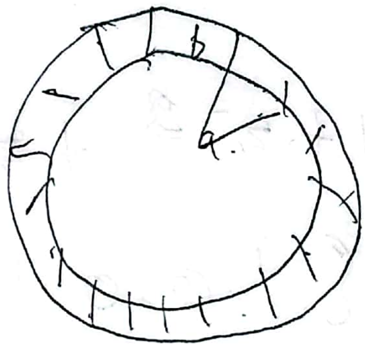
L.H.S. :



ROC.

(c) $x(n) = a^n u(n) + b^n u(-n-1)$

$a < b$.



(d) Convolution property:

$x_1(n) \xrightarrow{Z} X_1(z)$

$x_2(n) \xrightarrow{Z} X_2(z)$

$x_1(n) * x_2(n) \xrightarrow{Z} X_1(z) \cdot X_2(z)$

$$x(z) = \frac{1}{1-az^{-1}} \quad |z| > |a|$$

$$x(n) = a^n u(n)$$

$$x(z) = \cancel{1+z^{-3}} \quad 1 + z^{-3} + z^{-6}$$

$$x(z) = 1 + z^{-3} + z^{-6}$$

$$x(n) = \{1, 0, 0, 1, 0, 0, 1\}$$

3.5.3 : Causality & Stability : A causal LTI system is one whose unit impulse response satisfies the condition

$$h(n) = 0, \quad n < 0$$

A stable LTI system is one whose

unit-impulse response satisfies the condition.

$$\sum_{n=-\infty}^{\infty} |h(n)| < \infty$$

Ex. 2.5.2 An LTI system is characterized by the system function

$$H(z) = \frac{3 - 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$$

$$= \frac{1}{1 - \frac{1}{2}z^{-1}} + \frac{2}{1 - 3z^{-1}}$$

Specify the ROC of $H(z)$ and determine $h(n)$ for the following conditions:-

ⓐ The system is stable.

ⓑ " " " causal

ⓒ " " " anti- "

if causal:

(b) $h(n) = \left(\frac{1}{2}\right)^n u(n) + 2\cdot(3)^n u(n)$

(c) if anticausal:

$$h(n) = -\left(\frac{1}{2}\right)^n u(-n-1) - 2(3)^n u(-n-1)$$

(a) $\frac{1}{2} < |z| < 3$

$$h(n) = \left(\frac{1}{2}\right)^n u(n) - 2(3)^n u(-n-1)$$

Ex: 3.5-8: Determine the response of the system, $y(n) = \frac{5}{6} y(n-1) - \frac{1}{6} y(n-2) + x(n)$ to the input signal $x(n) = \delta(n) - \frac{1}{3}\delta(n-1)$

$Y(z) = H(z) X(z)$

$\downarrow$

$y(n)$

$$y(n) = \frac{5}{6} y(n-1) - \frac{1}{6} y(n-2) + x(n)$$

$$Y(z) = \frac{5}{6} z^{-1} Y(z) - \frac{1}{6} z^{-2} Y(z) + X(z)$$

$$Y(z) - \frac{5}{6} z^{-1} Y(z) + \frac{1}{6} z^{-2} Y(z) = X(z)$$

$$Y(z) \cdot \left(1 - \frac{5}{6} z^{-1} + \frac{1}{6} z^{-2}\right) = X(z)$$

$$H(z) = \frac{1}{1 - \frac{5}{6} z^{-1} + \frac{1}{6} z^{-2}} = \frac{1}{\left(1 - \frac{1}{2} z^{-1}\right)\left(1 - \frac{1}{3} z^{-1}\right)}$$

$$X(z) = \left(1 - \frac{1}{3} z^{-1}\right)$$

$$Y(z) = H(z) X(z) = \frac{1}{1 - \frac{1}{2} z^{-1}}$$

$$y(n) = \left(\frac{1}{2}\right)^n u(n)$$

(*) one - sided z transform.

$$X(z) = \sum_{n=0}^{\infty} x(n) z^{-n}$$

OS

Final - 1st class.

03/05

(*) **Deadlock:-** A deadlock is a situat
where each of the computer process
for a resource which is being ass
to some another process.

In this situation, none of the

DSP- TT — Final.

Previous question

1) Write down the z-transforms of $\delta(n)$, $\delta(n-k)$ and $\delta(n+k)$.

Ans: $x(n) = \delta(n)$

$X(z) = 1 \cdot z^{-0}$

$= 1$

$x(n) = \delta(n-k)$

$X(z) = z^{-k}$

$x(n) = \delta(n+k)$

$X(z) = z^{k}$ Ans

2) Determine the z-transforms of $x(n) = [u(n) - u(n-10)]$.

Ans $X(z) = z[u(n) - u(n-10)]$

$= z[u(n)] - z[u(n-10)]$

$= \frac{1}{1-z^{-1}} - z^{-10} \cdot \frac{1}{1-z^{-1}}$

$$= (1 - z^{-10}) \cdot \frac{1}{1 - z^{-1}}$$

Ans.

③ Determine the convolution of the following pairs of signals by means of the z-transform.

$x(n) = \{1, -2, 1\}$ and $h(n) = \{1, 1, 1, 1, 1, 1\}$

Compute the convolution $x(n)$ of the signals:

$$x_1(z) = 1 - 2z^{-1} + z^{-2}$$

$$x_2(z) = 1 + z^{-1} + z^{-2} + z^{-3} + z^{-4} + z^{-5}$$

$$x(z) = x_1(z) \cdot x_2(z) = 1 - z^{-1} - z^{-6} + z^{-7}$$

$$x(n) = \{1, -1, 0, 0, 0, 0, -1, 1\}$$

Ans.

(4) An LTI system is characterized by the system function $H(z) = \frac{3-4z^{-1}}{1-3.5z^{-1}+1.5z^{-2}}$. Determine the ROC and $h(n)$ if the system is causal and if the system is anticausal.

Ans: $H(z) = \frac{3-4z^{-1}}{1-3.5z^{-1}+1.5z^{-2}}$

$$= \frac{1}{1-\frac{1}{2}z^{-1}} + \frac{2}{1-3z^{-1}}$$

Specify the ROC of $H(z)$ and determine $h(n)$ for the following condition:

(a) The system is stable.

(b) " " is causal.

(c) " " " anti- " .

(a) $\frac{1}{2} < |z| < 3$

$h(n) = (\frac{1}{2})^n u(n) - 2(3)^n u(-n-1)$

(b) $h(n) = (\frac{1}{2})^n u(n) + 2\cdot(3)^n u(n)$

(c) $h(n) = -(\frac{1}{2})^n u(-n-1) - 2(3)^n u(-n-1)$.

Ans.

⑤ Determine the system function $H(z)$ and unit impulse response of the system described by $y(n) = 0.5y(n-1) - 2x(n)$

Ans:- $y(n) = 0.5y(n-1) - 2x(n)$

$$Y(z) = 0.5z^{-1}Y(z) - 2X(z)$$

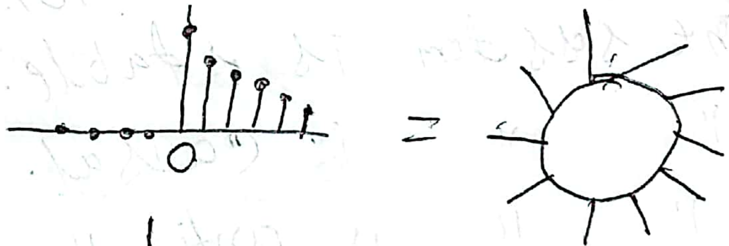
$$Y(z)(1 - 0.5z^{-1}) = -2X(z)$$

$$\frac{Y(z)}{X(z)} = \frac{-2}{1-0.5z^{-1}}$$

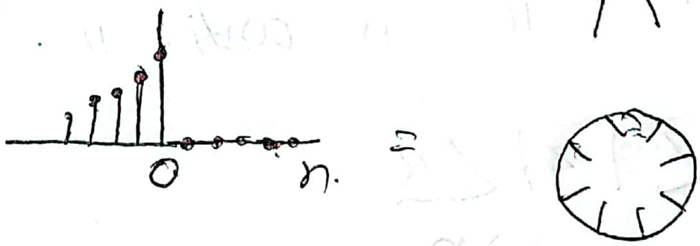
$$H(z) = -\frac{2}{1-0.5z^{-1}}$$

⑥ Plot the ROC of the following infinite-duration signals.

Causal:-



Anticausal:-



Two sided:-